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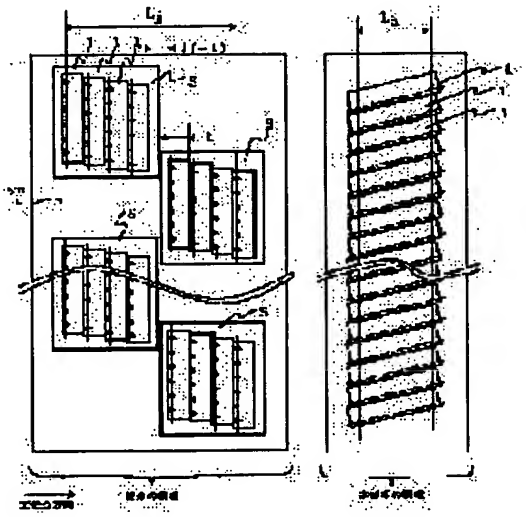
(54) INK JET RECORDING HEAD

(57)Abstract:
PROBLEM TO BE SOLVED: To realize high quality high speed recording by manufacturing a long recording head, in which the width of nozzle hole array is limited in the main scanning direction, with high yield.
SOLUTION: The ink jet recording head records scanning lines at a pitch PS by arranging a plurality of arrays of linear recording head modules, each having n nozzle holes arranged in row at a nozzle pitch P0, on a recording sheet. Width t of the linear recording head module is set to satisfy a relation (n-1)A/2<t≤nA (where, A=PS/P0 (P02-PS2)1/2, and the nozzle arrays of the linear recording head module are arranged continuously at an interval nPS in the direction perpendicular to the main scanning direction while inclining by an angle θ=sin-1(PS/P0) against the main scanning direction.



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CLAIMS

[Claim(s)]
[Claim 1] In the ink-jet recording head which a hole is arranged to a seriate in the nozzle pitch Po, and the width of face of this nozzle train and the right-angled direction carries out two or more trains arrangement of the linear recording head module of t, and records the scanning line of the scanning pitch Ps on a record form n nozzles — Width of face t of the aforementioned linear recording head module is made into A (n-1) / 2<t<=nA. And while leaning the nozzle train of the aforementioned linear recording head module to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form The ink-jet recording head characterized by arranging two or more these linear recording head modules at intervals of nPs in the direction perpendicular to the aforementioned main scanning direction. However, n is taken as the natural number and A=Ps/Po (Po2-Ps2) 1/2.
[Claim 2] a nozzle — the ink pressurized room which uses a hole as an opening edge The ink incurrent pore which leads ink to this ink pressurized room The manifold which supplies ink to this ink incurrent pore the ink-jet recording head equipped with the above — it is — the above — the width of face t of an imagination linear recording head module — A (n-1) / 2<t<=nA — carrying out — and the above — while leaning the nozzle train of an imagination linear recording head module to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form, it is characterized by arranging two or more these linear recording head modules at intervals of nPs in the direction perpendicular to the aforementioned main scanning direction However, n is taken as the natural number and A=Ps/Po (Po2-Ps2) 1/2.
[Claim 3] The ink-jet recording head characterized by setting the aforementioned nozzle pitch Po to Po=Ps/Po {(k2+1)Ph2}1/2 in an ink-jet recording head according to claim 1 or 2. However, k is the natural number and Ph is th predetermined value of the record dot pitch to main scanning direction.
[Claim 4] The ink-jet recording head characterized by setting the module width of face t of the aforementioned recording head, and angle-of-inclination theta as the value decided as Ps=Pr, arranging them at intervals of nPr in the direction perpendicular to the aforementioned main scanning direction, and making them into the shape of a lin in an ink-jet recording head according to claim 1 or 2 when the record dot density to a record form is Pr. [two or mor]

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the recording head of an ink-jet recording device, especially this invention is one relative scan to a record form, and relates to the long ink-jet recording head in which latus band-like record of width of face is possible.
[0002]
[Description of the Prior Art] In the serial scan type ink-jet recording device for continuation papers by the conventional technology In the longitudinal direction (form cross direction) which intersects the continuation direction (the direction of vertical scanning) of a continuation record form (henceforth continuation paper), The band-like picture for a party which moves a recording head (main scanning direction) and consists of two or more horizontal-scanning lines is recorded injecting ink, after that, the specified quantity ejection of the recording paper is carried out in the direction of vertical scanning, it is followed, horizontal scanning of the band-like picture of the following line is carried out, and it is recorded. And a picture is recorded by repeating this horizontal scanning and vertical scanning.
[0003] the number of the horizontal-scanning lines of band-like record recordable on per horizontal scanning of a recording head in order to gather recording rate in such a serial scan type ink-jet recording device — it is necessary to increase — this sake — many nozzles — the long recording head which has arranged the nozzle cell containing a hole is used
[0004] furthermore, the case of a high-speed ink-jet recording device — the nozzle for the number of scanning lines required for record to the limit of the cross direction of continuation paper — the line recording head of the long picture which has arranged the nozzle cell which has a hole is used
[0005] Although there is the method of forming many nozzle cells at once in the shape of a line as a method of realizing such a long recording head, generally by this method, the yield of manufacture is bad. Moreover, when some in which at least one ink regurgitation property differs are in many nozzle cells, possibility that the record dot by this will cause degradation of printing quality notably is high.
[0006] Then, as a method of realizing other long recording heads, there is the method of putting in order and combining the short length good recording head module of the manufacture yield. The long recording head by this method is indicated by JP,03-5992,B.
[0007]
[Problem(s) to be Solved by the Invention] Since the method of putting in order two or more modules of the short length recording head mentioned above, and combining them raised the manufacture yield, although cost reduction was possible for it, it had the following troubles.
[0008] namely, the conventional composition (left figure) of drawing 4 — setting — the nozzle to the direction of vertical scanning of a recording head — in order to realize the continuity of a hole, the sub recording head module S which arranged two or more recording head modules 1 crosswise [of a recording head 510] is made into one group, and the method which detaches this more than the width of face, and arranges it by turns alternately is adopted Of course, although it is possible to carry out alternate arrangement separately for every recording head module, record resolution of the recording head module 1 can be desired only less than [a nozzle pitch, equivalent, or it] in this case. Therefore, in order to make printing density into high resolution, the method of forming the sub recording head module S as shown in drawing 4, and arranging this alternately is common.
[0009] however — the alternate array of such a sub recording head module S — the width of face (Lj) of the main scanning direction of a recording head 510 — a mounting top — large — not becoming — not obtaining — thereby — the nozzle of main scanning direction — the array width of face of a hole will also become large Therefore, the problem that variation arises in the landing position of a record dot position depending on change of the relative-displacement speed of continuation paper and a recording head 510 occurs. in order to obtain the recording head 510 of high resolution especially — the recording head module 1 — a large number — combining — the sub recording head module S — it is necessary to make — this — the width of face of the sub recording head module S — large — from a bird clapper — final — the array width of face (Lj) of main scanning direction — large — becoming — the nozzle of main scanning direction — since the array interval of a hole also becomes large, the variation in the landing position of a record dot will become still more serious
[0010] moreover, the nozzle mentioned above — the latus recording head of the array width of face of a hole has a problem other than the problem of landing position variation also about recording rate Especially, by the serial scan

typ printer, it is serious.
[0011] nam ly, the cas wher predetermined r cord paper width is recorded with a serial scan type ink jet printer -- specially — the nozzle of main scanning direction — in order for the array width of fac of a hol to print xactly to th ends of record paper width by the large recording h ad, it is becaus it is nec ssary to carry out horizontal scanning too many by the array width of fac
[0012] th plac which this inv ntion solv s the conv ntional abov troubles and is made into the purpos — the nozzle to main scanning dir ction — the long r cording head which pr ssed down th array spr ad of a hole is r alized, and it is in the thing with possible high quality and high-speed record for which a recording head is offered with the sufficient manufacture yield
[0013]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, it sets to this invention. In the ink-jet recording head which a hole is arranged to a seriate in the nozzle pitch Po, and the width of face of this nozzle train and the right-angled direction carries out two or more trains arrangement of the linear recording head module of t, and records the scanning line of the scanning pitch Ps on a record form n nozzles — Width of face t of the aforementioned linear recording head module is made into A (n-1) / 2<t<=nA. And while leaning the nozzle train of the aforementioned linear recording head module to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form Two or more these linear recording head modules have been arranged at intervals of nPs in the direction perpendicular to the aforementioned main scanning direction. In addition, n is the natural number and A=Ps/Po (Po2-Ps2) 1/2 her .
[0014] Or in order to solve the above-mentioned technical problem, it sets to this invention. a nozzle — with the ink pressurized room which uses a hole as an opening edge, and the ink incurrent pore which leads ink to this ink pressurized room A nozzle cell equipped with the manifold which supplies ink to this ink incurrent pore is arranged to n seriates in the nozzle pitch Po. In the ink-jet recording head which carries out two or more trains arrangement of this nozzle cell train as an imagination linear recording head module, and records the scanning line of the scanning pitch Ps on a record form Width of face t of an imagination linear recording head module is made into A (n-1) / 2<t<=nA. the above — and the above, while leaning the nozzle train of an imagination linear recording head module to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form Two or more these linear recording head modules have been arranged at intervals of ns in the direction perpendicular to the aforementioned main scanning direction.
[0015] In addition, in the recording head of one of the above, the aforementioned nozzle pitch Po is preferably set to Po=Ps/Po[(k2+1)Ph2]1/2. However, k is the natural number and Ph is the predetermined value of the record dot pitch to main scanning direction.
[0016] Furthermore, when the record dot density to a record form is Pr, it is good to set the module width of face t of the aforementioned recording head and angle-of-inclination theta as the value decided as Ps=Pr, to arrange more than one at intervals of nPr in the direction perpendicular to the aforementioned main scanning direction, and to consider as the shape of a line.
[0017]
[Embodiments of the Invention] Hereafter, an example of this invention is explained, referring to a drawing.
[0018] Drawing 1 is the perspective diagram of the ink-jet recording head by this invention, and is drawing which turned up the field which counters record space and is arranged, and carried out the tropia.
[0019] This recording head is equipped with the frame 2 which puts in order and holds two or more linear recording head module 1 and two or more of these recording head modules 1 by the position relation. two or more linear r cording head modules 1 — respectively — the same structure — it is — n nozzles — it has the nozzle train 100 which has arranged the hole to the seriate in the nozzle pitch Po
[0020] the elements on larger scale for three trains of the linear recording head module 1 with which drawing 2 has b en arranged at the frame 2 — it is — a nozzle — a hole — it is the plan seen from the arrangement side
[0021] the linear recording head module 1 — a nozzle — it consists of n nozzle cells 150 which use a hole 10 as op ning this nozzle cell 150 — a nozzle — it has the ink pressurized room 20 which uses a hole 10 as an opening edg , the ink incurrent pore 30 which leads ink to this ink pressurized room 20, and the manifold 40 which supplies ink to this ink incurrent pore 30 Moreover, driver elements (not shown), such as a piezoelectric device to which the volume of the ink pressurized room 20 is changed according to impression of a record signal, are attached in the ink pr ssurized room 20. In addition, each component is arranged and constituted in three dimensions to the p rpendicular direction of a drawing. Moreover, the structure of each nozzle cell is the same.
[0022] The operation of each nozzle cell is as follows.
[0023] for example, the time of record — a nozzle — when carrying out the regurgitation of the ink from hole 10a, th volume of ink pressurized-room 20a is made to increase by the driver element which is not illustrated first Thereby, the ink in manifold 40a supplied along with Arrow A flows into ink pressurized-room 20a through ink incurrent por 30a. Then, the volum of ink pressurized-room 20a d creases by th driv r lement. thereby — th ink in ink pressuriz d-room 20a — a nozzl — a hole — 10a — going — th direction of Arrow B — flowing — a nozzl — ink is breathed out from hol 10a ** arrival of this r gurgitation ink will be carri d out on a record form in the process relativ ly scann d to a r cord form in a r cording h ad, and it will form a r cord pictur .
[0024] Drawing 3 is xplanat ry drawing which is attached to th size of the lin ar recording head module of a recording h ad and arrangement by this invention, and is sh wn.
[0025] the linear r cording head m dul 1 — width of fac — t — it is — n nozzl s (they are six piec s when it is

drawing 3) — the hole 10 is arrang d in Pitch Po And width of face t is set up as follows. In addition, xplanation of derivation of this formula is mentioned later.
[0026]
[Equation 1]

$$(n-1)\frac{A}{2} < t \leq nA$$

但し

$$A = \frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

Furthermore, the nozzle train array direction leans only an angle theta to main scanning direction, and this linear recording head module 1 is arranged. This angle of inclination is theta=Sin −1 (Ps/Po). Here, Ps is the pitch (resolution) of the scanning line printed by one horizontal scanning of a recording head. Moreover, the linear recording head module 1 which leans in this way and is arranged is put in order at intervals of nPs in N pieces and the direction of vertical scanning.
[0027] according to this invention recording head mentioned above — each nozzle — the scanning line of Pitch Ps is r cordable in the regurgitation ink from a hole The recording width is about Nx (nxPs), and can realize y **** and a long recording head to increase the number N of arrays of the linear recording head module 1. Thus, in this recording head, since a long recording head can be constituted from a good small linear recording head module of the manufacture yield with a comparatively small nozzle cell, it is realizable with the yield sufficient on the whole.
[0028] Drawing 4 compares and shows a recording head conventionally which was constituted by putting the linear recording head module 1 in order by the conventional method in order to enable record of the scanning pitch Ps as well as the recording head by this invention, and this. In addition, all of the size of the head of the conventional Lilia r cording head module 1 and the linear recording head module 1 of this invention, the property of the ink r gurgitation, etc. are the same.
[0029] In drawing, the recording head sub module S put in order while shifting the recording head module 1 to main scanning direction at four pieces and main scanning direction, in order to realize the scanning pitch Ps is conventionally composed of the recording head by composition. and the nozzle to the longitudinal direction of a r cording head — the structure which detached the recording head sub module S crosswise [of a recording head] (main scanning direction) more than the width of face of a recording head sub module, and has arranged it by turns alternately crosswise in order to realize the continuity of a hole — becoming — **** —. the nozzle of main scanning direction — the array width of face Lj of a hole is large
[0030] on the other hand, the recording head by the composition of this invention — setting — the nozzle of main scanning direction — the array width of face Lh of a hole — the former — the nozzle of the main scanning direction of the recording head of composition — the array width of face Lj of a hole — narrow — a maximum of — it can be shortened to about about 1 / 2
[0031] Here, the derivation method of the upper limit of the width of face t of the recording head module 1 and a minimum is explained.
[0032] First, in drawing 3 , since a triangle A and a triangle B are right triangles of the similarity which has an acut angl theta, it becomes t1−/T1=y/Po. Therefore, it becomes T1=t1xPo/y (formula 1). On the other hand, since a triangle B is similarity, the right triangle C which has an acute angle theta serves as t2−/T2=y/Po, and T2=t2xPo/y (formula 2) is calculated.
[0033] the nozzle which is in a homotopic in the direction of vertical scanning of the adjoining recording head module 1 here — if the distance between holes is nPs and this distance is smaller than T1+T2 of drawing 3 , sinc each recording head module will adjoin and will be arranged, it is set to T1+T2 <=nPs (formula 3) moreover — and (formula 1) (formula 2) since it becomes T1+T2=(t1+t2) xPo/y=txPo/y, if this is introduced into (a formula 3), txPo/y<=nPs (formula 4) will be calculated
[0034] Therefore, t becomes as follows. In addition, it is y=(Po2−Ps2) 1/2.
[0035]
[Equation 2]

$$t \leq n\frac{Ps}{Po}y = n\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

on the other hand, it is shown in drawing 4 — as — the conventional composition — setting — the recording head sub module S — the nozzle of the recording head module 1 — a hole — to the distance Po of a between, the Po/Ps individual array is carried out so that it may become the scanning pitch Ps Moreover, if distance with another recording head sub module S by which contiguity arrang m nt is carried out alt rnat ly is set to t for conv nience, full [of the r cording h ad of composition / Lj] will serve as 2xPo/Psxt (formula 5) conv ntionally.
[0036] On the oth r hand, in the recording h ad of this inv ntion, full [th / Lh] is 1 (Po(n−1)2−Ps2)/2. Sinc the composition of this invention becom s advantag ous when full [this / Lj] is larger than full [of th r cording h ad of th c mposition of this invention / Lh], it is set to 2xPo/Psxt>(n−1) (P 2−Ps2) 1/2, and, finally b com s as follows.
[0037]

[Equation 3]

$$t > \frac{n \div 1}{2} \frac{Ps}{Po} \cdot \sqrt{Po^2 - Ps^2}$$

And th upper limit and minimum of width of fac t of th recording head module 1 consist of [several 2] and [s veral 3] as follows.

[0038]

[Equation 4]

$$\frac{n-1}{2} \frac{Ps}{Po} \sqrt{Po^2 - Ps^2} < t \leq n \frac{Ps}{Po} \sqrt{Po^2 - Ps^2}$$

ここで $A = \frac{Ps}{Po} \sqrt{Po^2 - Ps^2}$ とすると

$(n-1)\frac{A}{2} < t \leq nA$ となる。

That is, by t=nA, this rate of shortening serves as the maximum, and serves as Lh=Lj in t=(n-1) A/2.

[0039] In addition, it is a book, even if it is at the time of l= 0, although distance l between the recording head modules S which adjoin between the recording head sub modules S was made equal to the width of face t of the h ad module 1 in above-mentioned explanation.

[0040] thus — according to the recording head of this invention — the nozzle to main scanning direction — the array width of face of a hole can realize a narrow recording head, and can mitigate the problem of the landing position variation of the ink drop accompanying speed change of horizontal scanning moreover — application to the printer of especially a serial scan type — a nozzle — since it becomes unnecessary to scan only the decrement of the array width of face of a hole too many, improvement in substantial recording rate is possible

[0041] in order to make explanatory drawing intelligible in the above example — the nozzle of a recording head module — as for this value, the ratio of six pieces, and Po and Ps does not limit this invention, although the hole described the case where it was 4:1

[0042] drawing 5 — for example, the nozzle of the recording head module 1 — a hole — n — 64 pieces — it is — a nozzle — a hole — about 9.594 degrees theta is leaned for the recording head module which is 5mm, and pitch Po=6 / 300 inches, and thickness t are the examples which put two or more these recording head mho joules 1 in order, and can record a horizontal-scanning line by Ps=1 / 300 inches That is, although record of 300dpi is possible and it can be used also as an object for serial scan type printers by one horizontal scanning, when the record dot density Pr to a record form is 300dpi, it becomes suitable as a recording head for high speed line printers with constituting the long line recording head of record form width of face.

[0043] moreover, a nozzle — a hole — when recording on main scanning direction by the record dot density of 300dpi by carrying out Pitch Po as the following formula, in case a dot is arranged and recorded in the direction of vertical scanning, the drive timing of the nozzle cell 150 shown in drawing 2 can be arranged, and it is also possibl to simplify a drive timing circuit In addition, it is the value k is decided here and it is decided with the predetermined value of the record dot pitch to main scanning direction that the natural number and Ph will be, and, in the case of k= 6, Ph=1 / 300 inches, sets up at about 0.515mm.

[0044]

[Equation 5]

$$Po = \sqrt{(k^2 + 1)Ph^2}$$

Although drawing 6 is using the same recording head module as drawing 5 , it is the example of the recording head the scanning pitch Ps was made to correspond to 2/300 by leaning inclination theta of a recording head module to 19.47 degrees. By using this recording head and constituting the serial printer of 300dpi, printing by interlace scanning is attained and it becomes possible to attain improvement in quality of image.

[0045] That is, in performing interlace scanning which set up the scanning pitch Ps by m times the record dot density Pr, it becomes possible by making inclination theta of a recording head module into theta=Sin -1 (mPr/Po). However, m is the two or more natural numbers.

[0046] Drawing 7 and drawing 8 show other examples of the recording head of this invention.

[0047] the nozzle train 110 — the example of drawing 1 and drawing 2 — like — each recording head module 1 — v ry module — perf ct — not s parating — for xampl , th long orifice 210 of one sh et — a nozzl — th hole 11 and the nozzl train 110 ar form d Furthermore, package formation also of th ink pressurized room 120 or the manifold 140 is carried ut not by th configurati n of modul but by the laminating of a long board by which patt rning was carri d ut, and this long laminat 220 is stuck on the orific plat 210 bottom. On the th r hand, the driver lement which chang s the volum of th ink pr ssurized room 120 according to a record signal is constituted as a driver-elem nt modul 300 every n zzle train 110, and is put in order and stuck on th long laminat 220.

[0048] although th yield will b com bad sp cially if this xample constitutes a driver- lement modul in a long pictur -- a nozzle -- a hole tc. is suitable for them, when there is no problem in a manufacture top, specially the yield, ven if it forms other function parts in a long picture
[0049] mor over -- a high-definition r cord sake -- a nozzle -- although the array pr cision f a hol is required -- this xample -- one board -- etching, press punching or laser beam machining, el ctro foaming, tc. -- highly precis -- a nozzle -- it may be more advantag ous than the composition which includes th recording head module 1 mention d above in a fram at the point which can form a hol on manufacture
[0050] In addition, in the example of drawing 7 and drawing 8 , although only the driver element was made into the configuration of module, if it does not stop at this driver element but creates to a long picture among the components of a recording head, the yield is carrying out the configuration of module only of the component which becomes bad, and carrying out package composition of others, and can manufacture a recording head good without th yield.
[0051] In the above example, when the modularization of any of the nozzle components they are was carried out, it attached and stated. The recording head of drawing 9 and drawing 10 explained below shows an example in case there are no worries about the yield, when a nozzle component can be created with the sufficient yield by the long picture, namely, even if it does not consider as the configuration of module.
[0052] the nozzle which is a nozzle component -- the laminating of the long laminate 220 in which the orifice plate 210, the ink pressurized room 120, and manifold 140 of the long picture which has arranged the hole were formed, and the long driver-element accumulation board 310 is carried out, and a long recording head is constituted
[0053] the composition of this example -- the above-mentioned composition -- ** -- if it checks -- n nozzles -- th nozzle cell 150 which uses a hole 11 as opening can find out the linear recording head module 400 of the imagination arranged in the nozzle pitch Po at the seriate To this virtual linear recording head module 400, the width of face t of the linear recording head module stated in the precedent, and by inclining and applying theta and two or mor configuration methods to a longitudinal direction, it is possible to press down narrowly the nozzle configuration width of face to main scanning direction, and the technical problem of this invention can be attained.
[0054] Although the above explanation described the case where nozzle **** of a linear recording head module was formed on the straight line at the single tier, if it may be arranged in predetermined width of face along with the straight line at the seriate for the recording characteristic improvement, the improvement on manufacture, etc., it is possible to attain the technical problem of this invention.
[0055] Moreover, in each above-mentioned example, although explained using an ink-jet recording method as a r cording method, it does not remain in an ink-jet recording method, but can apply also to the recording head of oth r recording methods which put in order and record many record cells, such as thermal recording and a wire dot recording method.
[0056]
[Effect of the Invention] according to this invention -- the nozzle to main scanning direction -- the recording head of a long picture with the narrow array width of face of a hole can be realized with the sufficient manufacture yield, the problem of the ink particle landing position variation accompanying speed change of horizontal scanning can b mitigated, and high-definition record is attained moreover -- the case where it applies to a serial scan type printer -- a nozzle -- since it becomes unnecessary to scan only the decrement of the array width of face of a hole too many, improvement in substantial recording rate is also possible

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[Translation done.]

*NOTICES *

TECHNICAL FIELD

[Industrial Application] About the recording head of an ink-jet recording device, especially this invention is one relative scan to a record form, and relates to the long ink-jet recording head in which the band-like record with wide width of face is possible.

[Translation done.]

PRIOR ART

[Description of the Prior Art] With the serial scan type ink-jet recording device for continuation papers by the conventional technology Injecting ink, the band-like picture for a party which moves a recording head (main scanning dir ction) and consists of two or more horizontal-scanning lines is recorded, after that, the specified quantity ejection of the recording paper is carried out in the direction of vertical scanning, it is followed, horizontal scanning of the band-like picture of the following line is carried out to the longitudinal direction (form cross direction) which intersects the continuation direction (the direction of vertical scanning) of a continuation record form (henceforth continuation paper), and it is recorded on it. And a picture is recorded by repeating this horizontal scanning and vertical scanning.

[0003] the number of the horizontal-scanning lines of band-like record recordable on per horizontal scanning of a recording head in order to gather recording rate in such a serial scan type ink-jet recording device — it is necessary to increase — this sake — many nozzles — the long recording head which has arranged the nozzle cell containing a hole is used

[0004] furthermore, the case of a high-speed ink-jet recording device — the nozzle for the number of scanning lines required for record to the limit of the cross direction of continuation paper — the line recording head of the long picture which has arranged the nozzle cell which has a hole is used

[0005] Although there is the method of forming many nozzle cells at once in the shape of a line as a method of realizing such a long recording head, generally by this method, the yield of manufacture is bad. Moreover, when some in which at least one ink **** property differs are in many nozzle cells, possibility that the record dot by this will cause degradation of printing quality notably is high.

[0006] Then, as a method of realizing other long recording heads, there is the method of putting in order and combining the short length good recording head module of the manufacture yield. The long recording head by this method is indicated by JP,03-5992,B.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] according to this invention — the nozzle to main scanning direction — the recording head of a long picture with the narrow array width of face of a hole can be realized with the sufficient manufacture yield, the problem of the ink particle landing position variation accompanying speed change of horizontal scanning can b mitigated, and high-definition record is attained moreover — the case where it applies to a serial scan type printer — a nozzle — since it becomes unnecessary to scan only the decrement of the array width of face of a hole too many, improvement in substantial recording rate is also possible

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since the method of putting in order two or more modules of the short length recording head mentioned above, and combining them raised the manufacture yield, although cost reduction was possible for it, it had the following troubles.
[0008] namely, the conventional composition (left figure) of drawing 4 -- setting -- the nozzle to the direction of v rtical scanning of a recording head -- in order to realize the continuity of a hole, the sub recording head module S which arranged two or more recording head modules 1 crosswise [of a recording head 510] is made into one group, and the method which detaches this more than the width of face, and arranges it by turns alternately is adopted Of course, although it is possible to carry out alternate arrangement separately for every recording head module, record resolution of the recording head module 1 can be desired only less than [a nozzle pitch, equivalent, or it.] in this case. Therefore, in order to make printing density into high resolution, the method of forming the sub recording head module S as shown in drawing 4, and arranging this alternately is common.
[0009] however -- the alternate array of such a sub recording head module S -- the width of face (Lj) of the main scanning direction of a recording head 510 -- a mounting top -- large -- not becoming -- not obtaining -- thereby -- the nozzle of main scanning direction -- the array width of face of a hole will also become large Therefore, the problem that variation arises in the landing position of a record dot position depending on change of the relative-displacement speed of continuation paper and a recording head 510 occurs: in order to obtain the recording head 510 of high resolution especially -- the recording head module 1 -- a large number -- combining -- the sub r cording head module S -- it is necessary to make -- this -- the width of face of the sub recording head module S -- large -- from a bird clapper -- final -- the array width of face (Lj) of main scanning direction -- large -- b coming -- the nozzle of main scanning direction -- since the array interval of a hole also becomes large, the variation in the landing position of a record dot will become still more serious
[0010] moreover, the nozzle mentioned above -- the latus recording head of the array width of face of a hole has a problem other than the problem of landing position variation also about recording rate Especially, by the serial scan typ printer, it is serious.
[0011] namely, the case where predetermined record paper width is recorded with a serial scan type ink jet printer -- especially -- the nozzle of main scanning direction -- in order for the array width of face of a hole to print exactly to the ends of record paper width by the large recording head, it is because it is necessary to carry out horizontal scanning too many by the array width of face
[0012] the place which this invention solves the conventional above troubles and is made into the purpose -- the nozzle to main scanning direction -- the long recording head which pressed down the array spread of a hole is r alized, and it is in the thing with possible high quality and high-speed record for which a recording head is offered with the sufficient manufacture yield

[Translation done.]

MEANS

[M ans for Solving the Problem] In order to solve the above-mentioned technical problem, it sets to this invention. In the ink-jet recording head which a hole is arranged to a seriate in the nozzle pitch Po, and the width of face of this nozzle train and the right-angled direction carries out two or more trains arrangement of the linear recording head module of t, and records the scanning line of the scanning pitch Ps on a record form n nozzles — Width of face t of the aforementioned linear recording head module is made into A (n-1) / 2<t<=nA. And while leaning the nozzle train of the aforementioned linear recording head module to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form Two or mor these linear recording head modules have been arranged at intervals of nPs in the direction perpendicular to the aforementioned main scanning direction. In addition, n is the natural number and A=Ps/Po (Po2-Ps2)-1/2 here.

[0014] Or in order to solve the above-mentioned technical problem, it sets to this invention. a nozzle — with the ink pressurized room which uses a hole as an opening edge, and the ink incurrent pore which leads ink to this ink pressurized room A nozzle cell equipped with the manifold which supplies ink to this ink incurrent pore is arranged to n seriates in the nozzle pitch Po. In the ink-jet recording head which carries out two or more trains arrangement of this nozzle cell train as an imagination linear recording head module, and records the scanning line of the scanning pitch Ps on a record form Width of face t of an imagination linear recording head module is made into A (n-1) / 2<t<=nA. the above — and the above, while leaning the nozzle train of an imagination linear recording head modul to theta=Sin -1 (Ps/Po) and arranging it to the main scanning direction used as a recording head and the relative-displacement direction of a record form Two or more these linear recording head modules have been arranged at intervals of ns in the direction perpendicular to the aforementioned main scanning direction.

[0015] In addition, in the recording head of one of the above, the aforementioned nozzle pitch Po is preferably set to Po=Ps/Po{(k2+1)Ph2}1/2. However, k is the natural number and Ph is the predetermined value of the record dot pitch to main scanning direction.

[0016] Furthermore, when the record dot density to a record form is Pr, it is good to set the module width of face t of the aforementioned recording head and angle-of-inclination theta as the value decided as Ps=Pr, to arrange more than one at intervals of nPr in the direction perpendicular to the aforementioned main scanning direction, and to consider as the shape of a line.

[0017]

[Embodiments of the Invention] Hereafter, an example of this invention is explained, referring to a drawing.

[0018] Drawing 1 is the perspective diagram of the ink-jet recording head by this invention, and is drawing which turn d up the field which counters record space and is arranged, and carried out the tropia.

[0019] This recording head is equipped with the frame 2 which puts in order and holds two or more linear recording head module 1 and two or more of these recording head modules 1 by the position relation. two or more linear recording head modules 1 — respectively — the same structure — it is — n nozzles — it has the nozzle train 100 which has arranged the hole to the seriate in the nozzle pitch Po

[0020] the elements on larger scale for three trains of the linear recording head module 1 with which drawing 2 has b n arranged at the frame 2 — it is — a nozzle — a hole — it is the plan seen from the arrangement side

[0021] the linear recording head module 1 — a nozzle — it consists of n nozzle cells 150 which use a hole 10 as opening this nozzle cell 150 — a nozzle — it has the ink pressurized room 20 which uses a hole 10 as an opening dg , the ink incurrent pore 30 which leads ink to this ink pressurized room 20, and the manifold 40 which supplies ink to this ink incurrent pore 30 Moreover, driver elements (not shown), such as a piezoelectric device to which the volume of the ink pressurized room 20 is changed according to impression of a record signal, are attached in the ink pressurized room 20. In addition, each component is arranged and constituted in three dimensions to the perpendicular direction of a drawing. Moreover, the structure of each nozzle cell is the same.

[0022] The operation of each nozzle cell is as follows.

[0023] for example, the time of record — a nozzle — when carrying out the regurgitation of the ink from hole 10a, the volum of ink pr ssurized-room 20a is mad to incr as by the driver element which is not illustrat d first Thereby, the ink in manifold 40a suppli d along with Arrow A flows into ink pressurized-room 20a through ink incurrent pore 30a. Then, the volume of ink pressurized-room 20a d creas s by the driver lem nt. ther by — th ink in ink pressuriz d-room 20a — a nozzle — a h l — 10a — going — th direction of Arrow B — flowing — a nozzl — ink is breathed out from hol 10a ** arrival of this regurgitation ink will be carri d out n a r c rd form in the process r latively scann d t a r cord form in a r cording h ad, and it will form a r cord pictur .

[0024] Drawing 3 is explanatory drawing which is attach d to th size of the lin ar rec rding head modul of a

recording head and arrangement by this inv ntion, and is shown.
[0025] th linear r cording head modul 1 — width of face — t — it is — n nozzl s (they are six pi ces when it is drawing 3) — the hole 10 is arranged in Pitch Po And width of face t is s t up as follows. In addition, explanation of derivation of this formula is mentioned lat r.
[0026]
[Equation 1]

$$(n-1)\frac{A}{2} < t \leq nA$$

但し

$$A = \frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

Furthermore, the nozzle train array direction leans only an angle theta to main scanning direction, and this linear recording head module 1 is arranged. This angle of inclination is theta=Sin −1 (Ps/Po). Here, Ps is the pitch (r solution) of the scanning line printed by one horizontal scanning of a recording head. Moreover, the linear recording head module 1 which leans in this way and is arranged is put in order at intervals of nPs in N pieces and th direction of vertical scanning.
[0027] according to this invention recording head mentioned above — each nozzle — the scanning line of Pitch Ps is r cordable in the regurgitation ink from a hole The recording width is about Nx (nxPs), and can realize y **** and a long recording head to increase the number N of arrays of the linear recording head module 1. Thus, in this recording head, since a long recording head can be constituted from a good small linear recording head module of the manufacture yield with a comparatively small nozzle cell, it is realizable with the yield sufficient on the whole.
[0028] Drawing 4 compares and shows a recording head conventionally which was constituted by putting the linear r cording head module 1 in order by the conventional method in order to enable record of the scanning pitch Ps as well as the recording head by this invention, and this. In addition, all of the size of the head of the conventional Lilia r cording head module 1 and the linear recording head module 1 of this invention, the property of the ink r gurgitation, etc. are the same.
[0029] In drawing, the recording head sub module S put in order while shifting the recording head module 1 to main scanning direction at four pieces and main scanning direction, in order to realize the scanning pitch Ps is conventionally composed of the recording head by composition. and the nozzle to the longitudinal direction of a r cording head — the structure which detached the recording head sub module S crosswise [of a recording head] (main scanning direction) more than the width of face of a recording head sub module, and has arranged it by turns alt rnately crosswise in order to realize the continuity of a hole — becoming — **** — the nozzle of main scanning direction — the array width of face Lj of a hole is large
[0030] on the other hand, the recording head by the composition of this invention — setting — the nozzle of main scanning direction — the array width of face Lh of a hole — the former — the nozzle of the main scanning direction of the recording head of composition — the array width of face Lj of a hole — narrow — a maximum of — it can be shortened to about about 1 / 2
[0031] Here, the derivation method of the upper limit of the width of face t of the recording head module 1 and a minimum is explained.
[0032] First, in drawing 3 , since a triangle A and a triangle B are right triangles of the similarity which has an acut angle theta, it becomes t1−/T1=y/Po. Therefore, it becomes T1=t1xPo/y (formula 1). On the other hand, since a triangle B is similarity, the right triangle C which has an acute angle theta serves as t2−/T2=y/Po, and T2=t2xPo/y (formula 2) is calculated.
[0033] the nozzle which is in a homotopic in the direction of vertical scanning of the adjoining recording head module 1 here — if the distance between holes is nPs and this distance is smaller than T1+T2 of drawing 3 , since each recording head module will adjoin and will be arranged, it is set to T1+T2 <=nPs (formula 3) moreover — and (formula 1) (formula 2) since it becomes T1+T2=(t1+t2) xPo/y=txPo/y, if this is introduced into (a formula 3), txPo/y<=nPs (formula 4) will be calculated
[0034] Therefore, t becomes as follows. In addition, it is y=(Po2−Ps2) 1/2.
[0035]
[Equation 2]

$$t \leq n\frac{Ps}{Po}y = n\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

on the other hand, it is shown in drawing 4 — as — the conventional composition — setting — the recording head sub modul S — th nozzl of th recording head module 1 — a hole — to th distance Po of a b tween, the Po/Ps individual array is carried out so that it may b come the scanning pitch Ps Mor over, if distance with another recording head sub modul S by which contiguity arrang ment is carri d ut alternat ly is s t to t for conveni nc , full [of the r cording head of composition / Lj] will s rv as 2xPo/Psxt (formula 5) conv ntionally.
[0036] On the other hand, in th recording head of this inv ntion, full [th / Lh] is 1 (Po(n−1)2−Ps2)/2. Since th composition of this invention becom s advantageous when full [this / Lj] is larg r than full [of the r c rding h ad of the composition of this inv ntion / Lh], it is set to 2xPo/Psxt>(n−1) (Po2−Ps2) 1/2, and, finally b comes as

follows.
[0037]
[Equation 3]

$$t > \frac{n-1}{2}\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

And the upper limit and minimum of width of face t of the recording head module 1 consist of [several 2] and [several 3] as follows.
[0038]
[Equation 4]

$$\frac{n-1}{2}\frac{Ps}{Po}\sqrt{Po^2 - Ps^2} < t \leq n\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

ここで $A = \frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$ とすると

$(n-1)\frac{A}{2} < t \leq nA$ となる。

That is, by t=nA, this rate of shortening serves as the maximum, and serves as Lh=Lj in t=(n−1) A/2.
[0039] In addition, it is a book, even if it is at the time of l= 0, although distance l between the recording head modules S which adjoin between the recording head sub modules S was made equal to the width of face t of the h ad module 1 in above-mentioned explanation.
[0040] thus — according to the recording head of this invention — the nozzle to main scanning direction — the array width of face of a hole can realize a narrow recording head, and can mitigate the problem of the landing position variation of the ink drop accompanying speed change of horizontal scanning moreover — application to the printer of especially a serial scan type — a nozzle — since it becomes unnecessary to scan only the decrement of the array width of face of a hole too many, improvement in substantial recording rate is possible
[0041] in order to make explanatory drawing intelligible in the above example — the nozzle of a recording head module — as for this value, the ratio of six pieces, and Po and Ps does not limit this invention, although the hole described the case where it was 4:1
[0042] drawing 5 — for example, the nozzle of the recording head module 1 — a hole — n — 64 pieces — it is — a nozzle — a hole — about 9.594 degrees theta is leaned for the recording head module which is 5mm, and pitch Po=6 / 300 inches, and thickness t are the examples which put two or more these recording head mho joules 1 in ord r, and can record a horizontal-scanning line by Ps=1 / 300 inches That is, although record of 300dpi is possible and it can be used also as an object for serial scan type printers by one horizontal scanning, when the record dot density Pr to a record form is 300dpi, it becomes suitable as a recording head for high speed line printers with constituting the long line recording head of record form width of face.
[0043] moreover, a nozzle — a hole — when recording on main scanning direction by the record dot density of 300dpi by carrying out Pitch Po as the following formula, in case a dot is arranged and recorded in the direction of v rtical scanning, the drive timing of the nozzle cell 150 shown in drawing 2 can be arranged, and it is also possible to simplify a drive timing circuit In addition, it is the value k is decided here and it is decided with the predetermined value of the record dot pitch to main scanning direction that the natural number and Ph will be, and, in the case of k= 6, Ph=1 / 300 inches, sets up at about 0.515mm.
[0044]
[Equation 5]

$$Po = \sqrt{(k^2 + 1)Ph^2}$$

Although drawing 6 is using the same recording head module as drawing 5 , it is the example of the recording head the scanning pitch Ps was made to correspond to 2/300 by leaning inclination theta of a recording head module to 19.47 degrees. By using this recording head and constituting the serial printer of 300dpi, printing by interlace scanning is attained and it becomes possible to attain improvement in quality of image.
[0045] That is, in performing interlace scanning which set up the scanning pitch Ps by m times the record dot d nsity Pr, it becomes possible by making inclination theta of a recording head module into theta=Sin −1 (mPr/Po). However, m is the two or more natural numbers.
[0046] Drawing 7 and drawing 8 show other exampl s f the recording h ad of this invention.
[0047] the nozzle train 110 — th xample of drawing 1 and drawing 2 — like — each recording head module 1 — every module — p rfect — not s parating — for exampl , th long orifice 210 of on she t — a nozzl — th hol 11 and the nozzle train 110 are formed Furthermor , package formation also of the ink pr ssuriz d room 120 r th manifold 140 is carried out n t by the configuration of module but by the laminating of a long board by which patterning was carried out, and this long laminate 220 is stuck on th orific plat 210 bottom. On th oth r hand, the driv r l ment which changes the volum of th ink pressurized room 120 according to a r cord signal is

constitut d as a driver-element module 300 every nozzle train 110, and is put in order and stuck on the long laminate 220.

[0048] although the yield will b come bad esp cially if this xampl constitutes a driver- lement module in a long picture — a nozzle — a hole tc. is suitabl for them, when ther is no problem in a manufacture top, especially the yield, even if it forms other function parts in a long picture

[0049] mor over — a high-definition r cord sak — a nozzle — although the array precisi n of a hole is r quir d — this exampl — on board — tching, press punching or laser beam machining, el ctro foaming, etc. — highly pr cise — a nozzle — it may be more advantageous than the composition which includes the recording head module 1 mentioned above in a frame at the point which can form a hole on manufacture

[0050] In addition, in the example of drawing 7 and drawing 8 , although only the driver element was made into the configuration of module, if it does not stop at this driver element but creates to a long picture among the components of a recording head, the yield is carrying out the configuration of module only of the component which b comes bad, and carrying out package composition of others, and can manufacture a recording head good without the yield.

[0051] In the above example, when the modularization of any of the nozzle components they are was carried out, it attached and stated. The recording head of drawing 9 and drawing 10 explained below shows an example in case there are no worries about the yield, when a nozzle component can be created with the sufficient yield by the long picture, namely, even if it does not consider as the configuration of module.

[0052] the nozzle which is a nozzle component — the laminating of the long laminate 220 in which the orifice plate 210, the ink pressurized room 120, and manifold 140 of the long picture which has arranged the hole were formed, and the long driver-element accumulation board 310 is carried out, and a long recording head is constituted

[0053] the composition of this example — the above-mentioned composition — ** — if it checks — n nozzles — the nozzle cell 150 which uses a hole 11 as opening can find out the linear recording head module 400 of the imagination arranged in the nozzle pitch Po at the seriate To this virtual linear recording head module 400, the width of face t of the linear recording head module stated in the precedent, and by inclining and applying theta and two or mor configuration methods to a longitudinal direction, it is possible to press down narrowly the nozzle configuration width of face to main scanning direction, and the technical problem of this invention can be attained.

[0054] Although the above explanation described the case where nozzle **** of a linear recording head module was formed on the straight line at the single tier, if it may be arranged in predetermined width of face along with the straight line at the seriate for the recording characteristic improvement, the improvement on manufacture, etc., it is possible to attain the technical problem of this invention.

[0055] Moreover, in each above-mentioned example, although explained using an ink-jet recording method as a recording method, it does not remain in an ink-jet recording method, but can apply also to the recording head of other recording methods which put in order and record many record cells, such as thermal recording and a wire dot recording method.

[Translation done.]

*NOTICES *

DESCRIPTION OF DRAWINGS

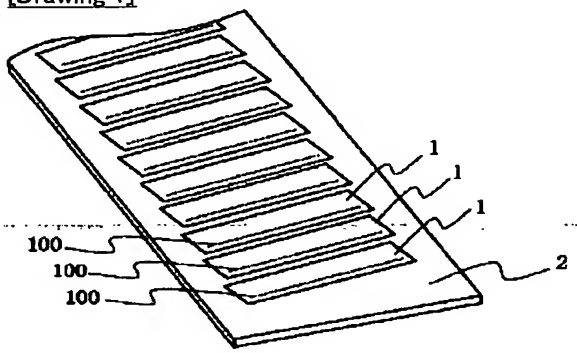
[Brief Description of the Drawings]
[Drawing 1] The perspective diagram of the ink-jet recording head used as an example of this invention.
[Drawing 2] The important section enlarged view of the recording head of drawing 1.
[Drawing 3] The conceptual diagram for explaining the size of the recording head of this invention, and arrangement.
[Drawing 4] The composition comparison view of the recording head of this invention, and the conventional r cording head.
[Drawing 5] The block diagram of the recording head used as other examples of this invention.
[Drawing 6] The block diagram of the recording head used as other examples of this invention.
[Drawing 7] The perspective diagram of the ink-jet recording head used as other examples of this invention.
[Drawing 8] The important section enlarged view of the recording head of drawing 7 .
[Drawing 9] The perspective diagram of the ink-jet recording head used as other examples of this invention.
[Drawing 10] The important section enlarged view of the recording head of drawing 9 .
[Description of Notations]
1 — a linear recording head module and 2 — a frame, and 10, 10a and 11 — a nozzle — a hole and 20 — an ink pressurized room and 30 — an ink incurrent pore and 40,140 — a manifold and 100 — a nozzle train and 110 — an orifice — a hole and 120 — for a nozzle cell and 210, as for a long laminate and 300, an orifice plate and 220 are [an ink pressurized room and 130 / an ink incurrent pore and 150 / a driver-element module and 310] driver- l ment accumulation boards Moreover, A and B show the direction of an ink style.

[Translation done.]

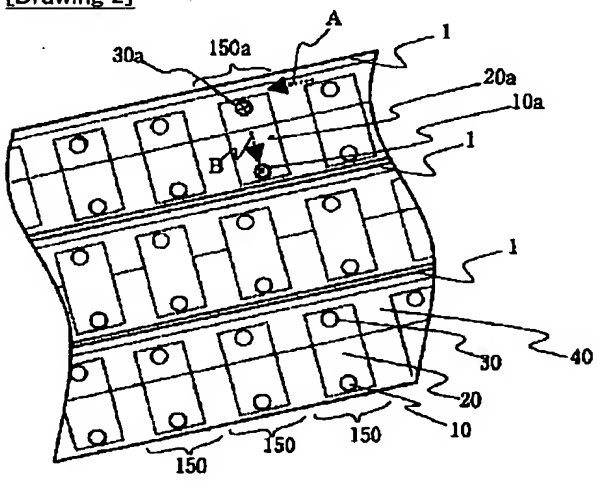
*NOTICES *

DRAWINGS

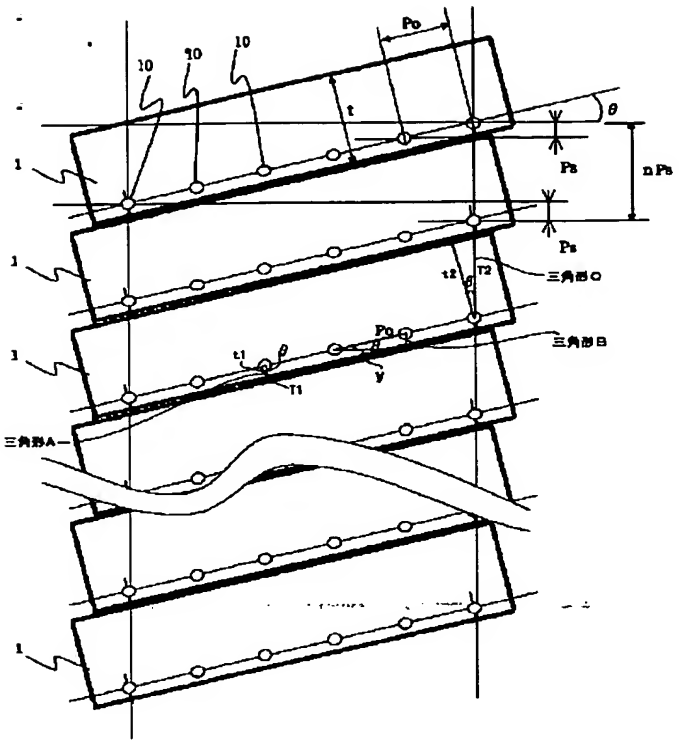
[Drawing 1]



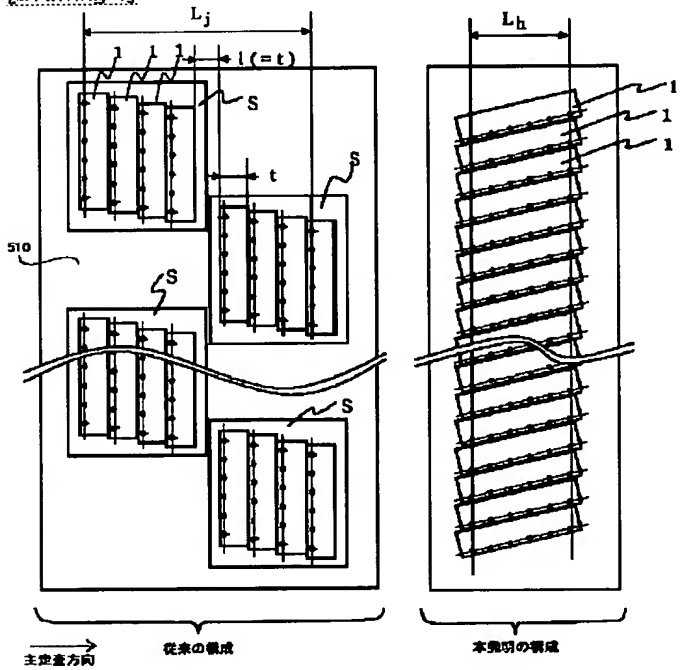
[Drawing 2]



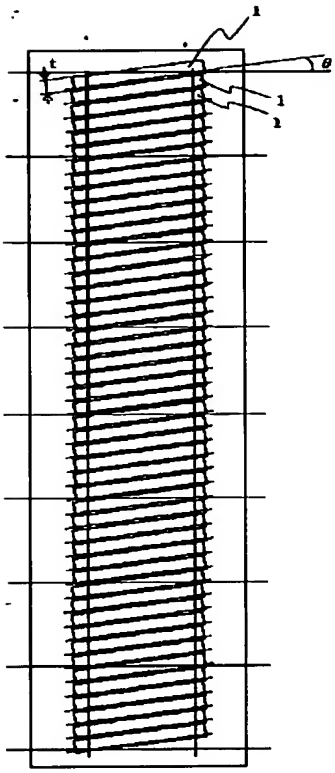
[Drawing 3]



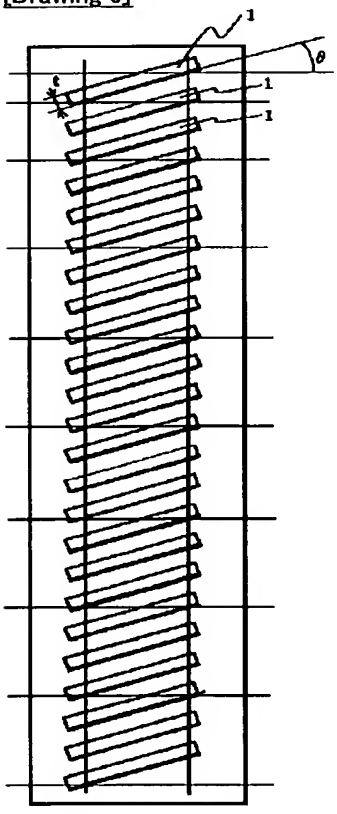
[Drawing 4]



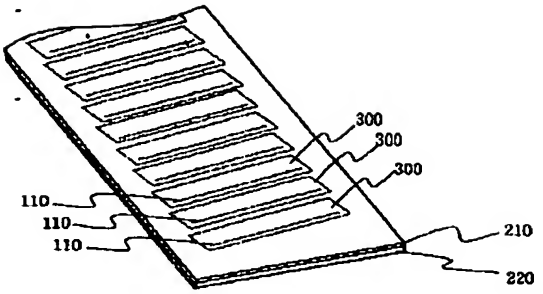
[Drawing 5]



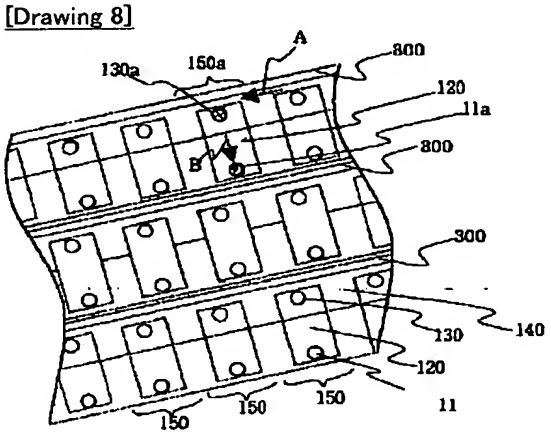
[Drawing 6]



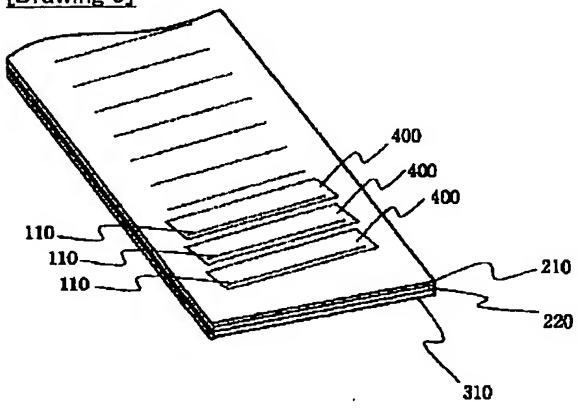
[Drawing 7]



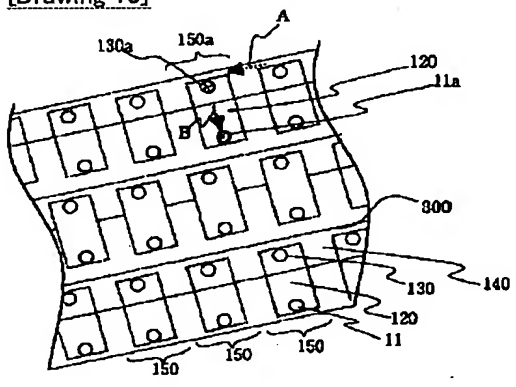
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

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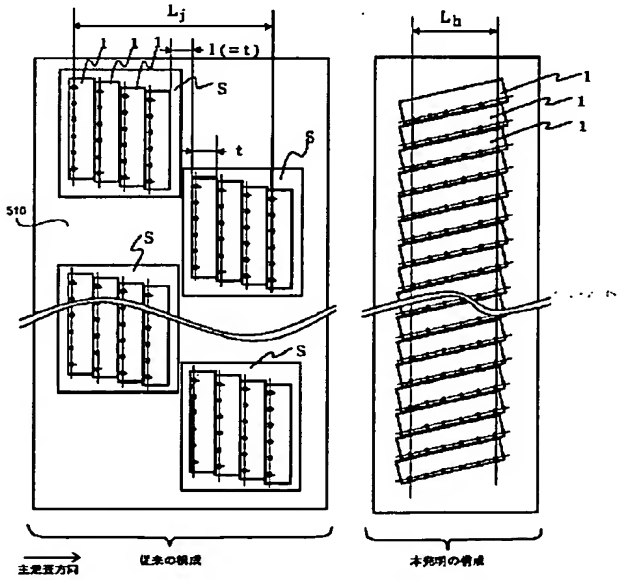
最終頁に続く

(54)【発明の名称】　インクジェット記録ヘッド

(57)【要約】
【課題】　本発明は、主走査方向へのノズル孔配列幅の広がりを押さえた長尺記録ヘッドを製造歩留まり良く実現し、高品質・高速記録が可能な、インクジェット記録ヘッドを提供することにある
【課題を解決するための手段】　ｎ個のノズル孔をノズルピッチＰｏで列状に配置したリニア記録ヘッドモジュールを複数列記録用紙上に配置し、走査ピッチPsの走査線を記録するインクジェット記録ヘッドであって、該リニア記録ヘッドモジュールの幅ｔを、（ｎ－１）Ａ／２＜ｔ≦ｎＡとし、更にリニア記録ヘッドモジュールのノズル列を主走査方向に対して$\theta = \mathrm{Sin}^{-1}(Ps/Po)$傾けながら、主走査方向と垂直な方向に間隔ｎPsで連続的に並べて配置する。ただし、$A = Ps/Po\ (Po^2 - Ps^2)^{1/2}$とする。



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【特許請求の範囲】

【請求項１】ｎ個のノズル孔をノズルピッチＰｏで列状に配置し、このノズル列と直角方向の幅がｔのリニア記録ヘッドモジュールを複数列配置し、記録用紙上に走査ピツチＰｓの走査線を記録するインクジェット記録ヘッドにおいて、

前記リニア記録ヘッドモジュールの幅ｔを（ｎ－１）Ａ／２＜ｔ≦ｎＡとし、かつ前記リニア記録ヘッドモジュールのノズル列を記録ヘッドと記録用紙の相対移動方向となる主走査方向に対して$\theta = Sin^{-1}(Ps/Po)$に傾けて配置すると共に、このリニア記録ヘッドモジュールを前記主走査方向と垂直な方向に間隔ｎＰｓで複数個配置することを特徴とするインクジェット記録ヘッド。但し、ｎは自然数、$A = Ps/Po\ (Po^2 - Ps^2)^{1/2}$とする。

【請求項２】ノズル孔を開口端とするインク加圧室と、該インク加圧室にインクを導くインク流入孔と、該インク流入孔にインクを供給するマニホールドとを備えるノズルセルをノズルピッチＰｏで列状にｎ個配置し、このノズルセル列を仮想的なリニア記録ヘッドモジュールとして複数列配置し、記録用紙上に走査ピツチＰｓの走査線を記録するインクジェット記録ヘッドにおいて、

前記仮想的なリニア記録ヘッドモジュールの幅ｔを（ｎ－１）Ａ／２＜ｔ≦ｎＡとし、かつ前記仮想的なリニア記録ヘッドモジュールのノズル列を記録ヘッドと記録用紙の相対移動方向となる主走査方向に対して$\theta = Sin^{-1}(Ps/Po)$に傾けて配置すると共に、このリニア記録ヘッドモジュールを前記主走査方向と垂直な方向に間隔ｎＰｓで複数個配置することを特徴とするインクジェット記録ヘッド。但し、ｎは自然数、$A = Ps/Po\ (Po^2 - Ps^2)^{1/2}$とする。

【請求項３】請求項１または２記載のインクジェット記録ヘッドにおいて、

前記ノズルピッチＰｏを$Po = Ps/Po\{(k^2+1)Ph^2\}^{1/2}$とすることを特徴とするインクジェット記録ヘッド。但し、ｋは自然数、Ｐｈは主走査方向への記録ドットピッチの所定値である。

【請求項４】請求項１または２記載のインクジェット記録ヘッドにおいて、

記録用紙への記録ドット密度がＰｒの時、前記記録ヘッドのモジュール幅ｔ及び傾き角θをＰｓ＝Ｐｒとして決まる値に設定し、前記主走査方向と垂直な方向に間隔ｎＰｒで複数個配置してライン状とすることを特徴とするインクジェット記録ヘッド。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はインクジェット記録装置の記録ヘッドに関し、特に記録用紙に対する相対的な一回の走査で、幅の広い帯状記録が可能な長尺インクジェット記録ヘッドに関する。

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【０００２】

【従来の技術】従来技術による連続紙向けシリアル走査型インクジェット記録装置では、連続記録用紙（以下連続紙という）の連続方向（副走査方向）と交叉する横方向（用紙幅方向）に、インクを噴射しながら記録ヘッドを移動（主走査方向）して複数の主走査線からなる一行分の帯状画像を記録し、その後副走査方向に記録紙を所定量紙送りし、続いて次の行の帯状画像を主走査して記録する。そして、この主走査と副走査を繰り返すことにより、画像を記録する。

【０００３】このようなシリアル走査型インクジェット記録装置において記録速度を上げるためには、記録ヘッドの主走査一回当たりに記録できる帯状記録の主走査線の数を増やす必要があり、このためには多数のノズル孔を含むノズルセルを配置した長尺記録ヘッドが使用される。

【０００４】更に、高速のインクジェット記録装置の場合、連続紙の幅方向いっぱいに、記録に必要な走査線数分のノズル孔を有するノズルセルを配置した長尺のライン記録ヘッドが使われる。

【０００５】このような長尺記録ヘッドを実現する方法としては、多数のノズルセルをライン状に一度に形成する方法があるが、この方法では一般に製造の歩留まりが悪い。また、多くのノズルセル中に一つでもインク吐出特性のばらついているものがあると、これによる記録ドットが印刷品質の劣化を顕著に引き起こす可能性が高い。

【０００６】そこで他の長尺記録ヘッドを実現する方法として、製造歩留まりの良い短尺の記録ヘッドモジュールを並べて組み合わせる方法がある。この方法による長尺記録ヘッドは、例えば特公平０３－５９９２号公報に開示されている。

【０００７】

【発明が解決しようとする課題】前述した短尺の記録ヘッドのモジュールを複数並べて組み合わせる方法は、製造歩留まりを向上させることができるため、コスト低減が可能ではあるが以下の問題点があった。

【０００８】すなわち、図４の従来構成（左図）においては、記録ヘッドの副走査方向へのノズル孔の連続性を実現するため、記録ヘッド５１０の幅方向に記録ヘッドモジュール１を複数配列したサブ記録ヘッドモジュールＳを１グループとし、これをその幅以上に離して千鳥状に交互に配置する方式が採用されている。もちろん、記録ヘッドモジュール１毎に個々に千鳥状配置することは可能であるが、この場合、記録ヘッドモジュール１の記録解像度はノズルピッチと同等、あるいはそれ以下しか望めない。従って、印刷密度を高解像度とするためには、図4に示すようなサブ記録ヘッドモジュールＳを設け、これを千鳥状に配置する方法が一般的である。

【０００９】しかしながら、このようなサブ記録ヘッド

モジュールＳの千鳥状の配列では、記録ヘッド５１０の主走査方向の幅（Ｌｊ）が実装上大きくならざるを得ず、これにより主走査方向のノズル孔の配列幅も広くなってしまう。よって、連続紙と記録ヘッド５１０との相対移動速度の変動によっては記録ドット位置の着地位置にバラツキが生ずるという問題が発生する。特に、高解像度の記録ヘッド５１０を得るためには、記録ヘッドモジュール１を多数組み合わせてサブ記録ヘッドモジュールＳを作る必要があり、これによってサブ記録ヘッドモジュールＳの幅が大きくなることから、最終的に主走査方向の配列幅（Ｌｊ）が大きくなって主走査方向のノズル孔の配列間隔も大きくなるため、記録ドットの着地位置のバラツキは更に深刻なものとなる。

【００１０】また、上述したノズル孔の配列幅の広い記録ヘッドは、着地位置バラツキの問題の他に記録速度についても問題がある。特に、シリアル走査型のプリンタでは深刻である。

【００１１】すなわち、シリアル走査型インクジェットプリンタで所定記録紙幅の記録を行う場合、特に主走査方向のノズル孔の配列幅が大きい記録ヘッドで記録紙幅の両端まできちんと印刷を行うためには、その配列幅分余計に主走査することが必要になるからである。

【００１２】本発明は従来の以上のような問題点を解決するもので、その目的とするところは、主走査方向へのノズル孔の配列幅広がりを押さえた長尺記録ヘッドを実現し、高品質・高速記録が可能な、記録ヘッドを製造歩留まりよく提供することにある。

【００１３】

【課題を解決するための手段】上記課題を解決するため、本発明においては、ｎ個のノズル孔をノズルピッチＰｏで列状に配置し、このノズル列と直角方向の幅がｔのリニア記録ヘッドモジュールを複数列配置し、記録用紙上に走査ピッチＰｓの走査線を記録するインクジェット記録ヘッドにおいて、前記リニア記録ヘッドモジュールの幅ｔを$(n-1)A/2<t\leqq nA$とし、かつ前記リニア記録ヘッドモジュールのノズル列を記録ヘッドと記録用紙の相対移動方向となる主走査方向に対して$\theta=Sin^{-1}(Ps/Po)$に傾けて配置すると共に、このリニア記録ヘッドモジュールを前記主走査方向と垂直な方向に間隔ｎＰｓで複数個配置した。なお、ここで、ｎは自然数、$A=Ps/Po\ (Po^2-Ps^2)^{1/2}$である。

【００１４】あるいは、上記課題を解決するため、本発明においては、ノズル孔を開口端とするインク加圧室と、該インク加圧室にインクを導くインク流入孔と、該インク流入孔にインクを供給するマニホールドとを備えるノズルセルをノズルピッチＰｏで列状にｎ個配置し、このノズルセル列を仮想的なリニア記録ヘッドモジュールとして複数列配置し、記録用紙上に走査ピッチＰｓの走査線を記録するインクジェット記録ヘッドにおいて、前記仮想的なリニア記録ヘッドモジュールの幅ｔを$(n-1)A/2<t\leqq nA$とし、かつ前記仮想的なリニア記録ヘッドモジュールのノズル列を記録ヘッドと記録用紙の相対移動方向となる主走査方向に対して$\theta=Sin^{-1}(Ps/Po)$に傾けて配置すると共に、このリニア記録ヘッドモジュールを前記主走査方向と垂直な方向に間隔ｎｓで複数個配置した。

【００１５】なお、上記いずれかの記録ヘッドにおいて、好ましくは、前記ノズルピッチＰｏを$Po=Ps/Po\{(k^2+1)\ Ph^2\}^{1/2}$とする。但し、ｋは自然数、Ｐｈは主走査方向への記録ドットピッチの所定値である。

【００１６】更に、記録用紙への記録ドット密度がＰｒの時、前記記録ヘッドのモジュール幅ｔ及び傾き角θをＰｓ＝Ｐｒとして決まる値に設定し、前記主走査方向と垂直な方向に間隔ｎＰｒで複数個配置してライン状とするとよい。

【００１７】

【発明の実施の形態】以下、本発明の一例を図面を参照しながら説明する。

【００１８】図１は、本発明によるインクジェット記録ヘッドの斜視図であり、記録紙面に対向して配置する面を上方に向け斜視した図である。

【００１９】本記録ヘッドは、複数個のリニア記録ヘッドモジュール１と、この複数個の記録ヘッドモジュール１を所定の位置関係で並べて保持する枠体２とを備える。複数個のリニア記録ヘッドモジュール１はそれぞれ同一構造であって、ｎ個のノズル孔をノズルピッチＰｏで列状に配置したノズル列１００を備えている。

【００２０】図２は、枠体２に配置されたリニア記録ヘッドモジュール１の３列分の部分拡大図であり、ノズル孔配置面から見た平面図である。

【００２１】リニア記録ヘッドモジュール１は、ノズル孔１０を開口とするｎ個のノズルセル１５０よりなる。このノズルセル１５０は、ノズル孔１０を開口端とするインク加圧室２０、このインク加圧室２０にインクを導くインク流入孔３０、このインク流入孔３０にインクを供給するマニホールド４０を備える。またインク加圧室２０には、インク加圧室２０の体積を記録信号の印加に応じて変化させる圧電素子等の駆動素子（図示せず）が取り付けられている。なお、各構成要素は、例えば図面の垂直方向に立体的に配置・構成されている。また、各ノズルセルの構造は同一である。

【００２２】各ノズルセルの動作は次の通りである。

【００２３】例えば、記録時、ノズル孔１０ａからインクを吐出する場合、まず、図示しない駆動素子によって、インク加圧室２０ａの体積を増加させる。これにより、矢印Ａに沿って供給されたマニホールド４０ａ中のインクは、インク流入孔３０ａを通じてインク加圧室２０ａに流れ込む。続いて、駆動素子によりインク加圧室２０ａの体積が減少する。これによりインク加圧室２０

ａ中のインクがノズル孔１０ａに向かって矢印Ｂの方向に流れ、ノズル孔１０ａからインクが吐出される。この吐出インクは、記録ヘッドを記録用紙に対して相対的に走査される過程で記録用紙上に飛着され、記録画像を形成することとなる。

【００２４】図３は本発明による記録ヘッドのリニア記録ヘッドモジュールの大きさと配置に付いて示す説明図である。

【００２５】リニア記録ヘッドモジュール1は幅がｔであり、ｎ個（図３の場合は６個）のノズル孔１０がピッチＰｏで配置されている。そして、幅ｔは下記の通り設定する。なお、この式の導出の説明は後述する。

【００２６】

【数１】

$$(n-1)\frac{A}{2} < t \leqq nA$$

但し

$$A = \frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

更に、このリニア記録ヘッドモジュール１は、ノズル列配列方向が主走査方向に対して角度θだけ傾けて配置されている。この傾き角は、$\theta = Sin^{-1}(Ps/Po)$である。ここで、Ｐｓは記録ヘッドの一回の主走査で印刷される走査線のピッチ（解像度）である。また、このように傾けて配置されているリニア記録ヘッドモジュール１をＮ個、副走査方向にｎＰｓの間隔で並べている。

【００２７】上述した本発明記録ヘッドによれば、各ノズル孔からの吐出インクによって、ピツチＰｓの走査線が記録可能である。その記録幅は、ほぼＮ×（ｎ×Ｐｓ）であり、リニア記録ヘッドモジュール１の配列数Ｎを増やすことにｙって、長尺記録ヘッドが実現できる。このように、本記録ヘッドにおいては、比較的ノズルセルの小さな、製造歩留まりの良い小型リニア記録ヘッドモジュールで長尺記録ヘッドが構成できるため、全体的に歩留まり良く実現できる。

【００２８】図４は、本発明による記録ヘッドと、これと同じく走査ピッチＰｓの記録を可能にするため、従来の方法でリニア記録ヘッドモジュール1を並べることにより構成した従来記録ヘッドを比較して示したものである。なお、従来のリリア記録ヘッドモジュール１と、本発明のリニア記録ヘッドモジュール１のヘッドの大きさ及びインク吐出の特性等は全て同一である。

【００２９】図において、従来構成による記録ヘッドでは、走査ピッチＰｓを実現するため、主走査方向に記録ヘッドモジュール１を４個、主走査方向にずらしながら並べた記録ヘッドサブモジュールＳが編成されている。そして、記録ヘッドの長手方向へのノズル孔の連続性を実現するため、記録ヘッドサブモジュールＳを記録ヘッドの幅方向（主走査方向）に、記録ヘッドサブモジュールの幅以上に離して千鳥状に交互に配置した構造となっており、主走査方向のノズル孔の配列幅Ｌｊは大きくなっている。

【００３０】これに対し、本発明の構成による記録ヘッドにおいては、主走査方向のノズル孔の配列幅Ｌｈは、従来構成の記録ヘッドの主走査方向のノズル孔の配列幅Ｌｊより狭く、最大約１／２程度まで短縮可能である。

【００３１】ここで、記録ヘッドモジュール１の幅ｔの上限及び下限の導出方法について説明する。

【００３２】まず、図３において、三角形Ａと三角形Ｂとは鋭角θを有する相似の直角三角形であるから、$t_1/T_1 = y/Po$となる。よって、$T_1 = t_1 \times Po/y$（式１）となる。一方、鋭角θを有する直角三角形Ｃも三角形Ｂとは相似であるから、$t_2/T_2 = y/Po$となり、$T_2 = t_2 \times Po/y$（式２）が求められる。

【００３３】ここで、隣接する記録ヘッドモジュール１の副走査方向において同位置にあるノズル孔の間の距離はｎＰｓであり、この距離が図３のT_1+T_2よりも小さければ、各記録ヘッドモジュールは隣接して配置されていることとなるので、$T_1+T_2 \leqq nPs$（式３）となる。また、（式１）及び（式２）より、$T_1+T_2 = (t_1+t_2) \times Po/y = t \times Po/y$となるから、これを（式３）に導入すると、$t \times Po/y \leqq nPs$（式４）が求められる。

【００３４】よって、ｔは下記の通りとなる。なお、$y = (Po^2 - Ps^2)^{1/2}$である。

【００３５】

【数２】

$$t \leqq n\frac{Ps}{Po}y = n\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

一方、図４に示すように、従来の構成において、記録ヘッドサブモジュールＳは記録ヘッドモジュール１のノズル孔間の距離Ｐｏに対して、走査ピッチＰｓとなるようにＰｏ／Ｐｓ個配列されている。また、千鳥状に隣接配置されている別の記録ヘッドサブモジュールＳとの距離を便宜上ｔとすると、従来構成の記録ヘッドの全幅Ｌｊは２×Ｐｏ／Ｐｓ×ｔ（式５）となる。

【００３６】これに対し、本発明の記録ヘッドにおいて、その全幅Ｌｈは$(n-1)(Po^2 - Ps^2)^{1/2}$である。この全幅Ｌｊが本発明の構成の記録ヘッドの全幅Ｌｈよりも大きい場合に本発明の構成が有利となるから、$2 \times Po/Ps \times t > (n-1)(Po^2 - Ps^2)^{1/2}$となり、最終的には下記の通りとなる。

【００３７】

【数３】

$$t > \frac{n-1}{2}\frac{Ps}{Po}\sqrt{Po^2 - Ps^2}$$

そして、〔数２〕と〔数３〕より、記録ヘッドモジュール１の幅ｔの上限及び下限は下記の通りとなる。

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【００３８】

【数４】

$$\frac{n-1}{2}\frac{Ps}{Po}\sqrt{Po^2-Ps^2} < t \leq n\frac{Ps}{Po}\sqrt{Po^2-Ps^2}$$

ここで $A=\frac{Ps}{Po}\sqrt{Po^2-Ps^2}$ とすると

$(n-1)\frac{A}{2} < t \leq nA$ となる。

すなわち、ｔ＝ｎＡでこの短縮率は最大となり、ｔ＝（ｎ－１）Ａ／２において、$L_h=L_j$となる。

【００３９】なお、上述の説明では、記録ヘッドサブモジュールS間と隣接する記録ヘッドモジュールＳとの間の距離lを、ヘッドモジュール１の幅ｔと等しいとしたが、ｌ＝０の時であっても本発明の効果が得られることに変わりはない。

【００４０】このように本発明の記録ヘッドによれば、主走査方向へのノズル孔の配列幅が狭い記録ヘッドが実現可能であり、主走査の速度変動に伴うインク液滴の着地位置バラツキの問題を軽減できる。また、特にシリアル走査型のプリンタへの適用では、ノズル孔の配列幅の減少分だけ余計に走査することが不要になるため、実質的な記録速度の向上が可能である。

【００４１】以上の例では、説明図を分かり易くするために記録ヘッドモジュールのノズル孔が６個、PoとPsの比が４：１である場合について述べたが、この値は本発明を限定するものではない。

【００４２】図５は、例えば記録ヘッドモジュール1のノズル孔ｎが64個であり、ノズル孔ピッチPo＝６／３００インチ、厚みｔが５ｍｍの記録ヘッドモジュールをθを約９．５９４°傾け、この記録ヘッドモージュール1を複数個並べた例であり、Ps＝１／３００インチで主走査線を記録できる。すなわち、一回の主走査で３００dpiの記録が可能であり、シリアル走査型のプリンタ用としても使用できるが、記録用紙への記録ドット密度Prが３００dpiの時には、記録用紙幅の長尺ライン記録ヘッドを構成することで、高速ラインプリンタ用の記録ヘッドとして好適になる。

【００４３】また、ノズル孔ピッチPoを下記式の通りとすることにより、主走査方向に３００dpiの記録ドット密度で記録する場合、副走査方向にドットを揃えて記録する際、図２に示すノズルセル１５０の駆動タイミングを揃えることができ、駆動タイミング回路を簡素化することも可能である。なお、ここで、ｋは自然数、Ｐｈは主走査方向への記録ドットピッチの所定値で決まる値であり、ｋ＝６、Ｐｈ＝１／３００インチの場合には約０．５１５ｍｍに設定する。

【００４４】

【数５】

8

$$Po=\sqrt{(k^2+1)Ph^2}$$

図６は図５と同じ記録ヘッドモジュールを使用しているが、記録ヘッドモジュールの傾きθを１９．４７°に傾けることにより、走査ピッチPsを２／３００に対応するようにした記録ヘッドの例である。この記録ヘッドを使用して、３００dpiのシリアルプリンタを構成することにより、インタレス走査による印刷が可能となり、画質の向上を達成することが可能になる。

【００４５】すなわち、走査ピッチPsを記録ドット密度Prのｍ倍に設定したインタレス走査を行う場合には、記録ヘッドモジュールの傾きθをθ=Sin^{-1}(ｍPr/Po)とすることで可能になる。ただし、ｍは２以上の自然数である。

【００４６】図７、図８は本発明の記録ヘッドの他の例を示すものである。

【００４７】ノズル列１１０は、図１、図２の例のように、各記録ヘッドモジュール１がモジュール毎に完全に別れておらず、例えば長尺の一枚のオリフィス２１０にノズル孔１１、そしてノズル列１１０が形成されている。更に、インク加圧室１２０やマニホールド１４０もモジュール構成ではなく、パターニングされた長尺の板の積層で一括形成され、この長尺積層板２２０がオリフィス板２１０の下側に貼り付けられている。一方、インク加圧室１２０の体積を記録信号に応じて変える駆動素子は、ノズル列１１０毎に駆動素子モジュール３００として構成され、長尺積層板２２０に並べて貼り付けられている。

【００４８】本例は、駆動素子モジュールを長尺に構成すると特に歩留まりが悪くなるが、ノズル孔等、他の機能部は長尺に形成しても製造上、特に歩留まりに問題がない場合に好適である。

【００４９】また、高画質記録のためにはノズル孔の配列精度が要求されるが、本例では、例えば一枚の板にエッチングやプレス打ち抜き、あるいはレーザ加工やエレクトロフォーミング等で高精度にノズル孔を形成出来る点で、前述した記録ヘッドモジュール１を枠体に組み入れる構成よりも製造上有利な場合がある。

【００５０】なお、図７、図８の例においては、駆動素子のみをモジュール構成にしたが、この駆動素子に止まらず、記録ヘッドの構成要素のうち、長尺に作成すると歩留まりが悪くなる構成要素のみをモジュール構成し、その他を一括構成することで、歩留まりなく良好に記録ヘッドを製造できる。

【００５１】以上の例では、ノズル構成要素のうちの何れかがモジュール化されている場合に付いて述べた。次に説明する図９、図１０の記録ヘッドは、ノズル構成要素を長尺で歩留まり良く作成出来る場合、すなわちモジュール構成としなくても歩留まりの心配がない場合の例を示すものである。

【００５２】ノズル構成要素であるノズル孔を配置した長尺のオリフィス板２１０、インク加圧室１２０及びマニホールド１４０を形成した長尺積層板２２０、そして長尺の駆動素子集積板３１０を積層して、長尺記録ヘッドを構成したものである。

【００５３】本例の構成を、前述の構成とと照らし合わせてみると、ｎ個のノズル孔１１を開口とするノズルセル１５０がノズルピッチＰｏで列状に配置された仮想のリニア記録ヘッドモジュール４００を見出すことが出来る。この仮想リニア記録ヘッドモジュール４００に対し、前例で述べたリニア記録ヘッドモジュールの幅ｔ、そして傾きθと、長手方向への複数配置方法を適用することにより、主走査方向へのノズル配列幅を狭く押さえることが可能で、本発明の課題を達成することが出来る。

【００５４】以上の説明では、リニア記録ヘッドモジュールのノズル孔列が直線上に一列に形成されている場合について述べたが、記録特性改善や製造上の改善等のため、直線に沿って所定の幅内に列状に配置されていえれば、本発明の課題を達成することが可能である。

【００５５】また、上述の各例では、記録方式としてインクジェット記録方式を用いて説明したが、インクジェット記録方式にとどまらず、感熱記録方式やワイヤドット記録方式など記録セルを多数並べて記録する他の記録方式の記録ヘッドにも適用できる。

【００５６】

【発明の効果】本発明によれば、主走査方向へのノズル孔の配列幅が狭い長尺の記録ヘッドを製造歩留まり良く実現可能であり、主走査の速度変動に伴うインク粒子着地位置バラツキの問題を軽減でき、高画質の記録が可能になる。また、シリアル走査型のプリンタに適用した場合には、ノズル孔の配列幅の減少分だけ余計に走査することが不要になるため、実質的な記録速度の向上も可能である。

【図面の簡単な説明】

【図１】　本発明の一例となるインクジェット記録ヘッドの斜視図。

【図２】　図1の記録ヘッドの要部拡大図。

【図３】　本発明の記録ヘッドの寸法と配置を説明するための概念図。

【図４】　本発明の記録ヘッドと従来の記録ヘッドの構成比較図。

【図５】　本発明の他の例となる記録ヘッドの構成図。

【図６】　本発明の他の例となる記録ヘッドの構成図。

【図７】　本発明の他の例となるインクジェット記録ヘッドの斜視図。

【図８】　図７の記録ヘッドの要部拡大図。

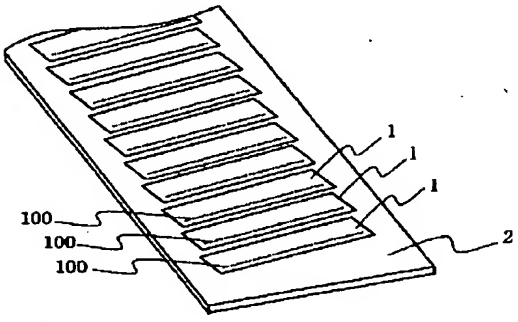
【図９】　本発明の他の例となるインクジェット記録ヘッドの斜視図。

【図１０】　図９の記録ヘッドの要部拡大図。

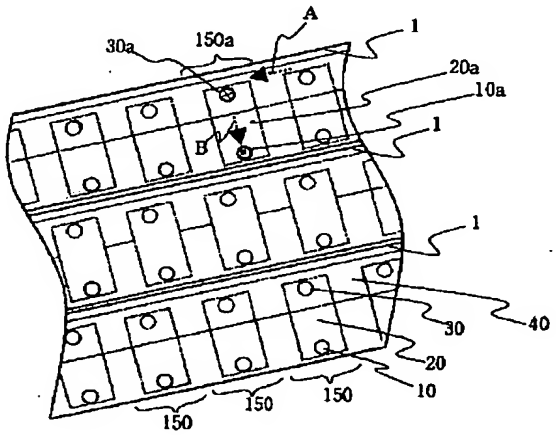
【符号の説明】

１はリニア記録ヘッドモジュール、２は枠体、１０、１０ａ、１１はノズル孔、２０はインク加圧室、３０はインク流入孔、４０、１４０はマニホールド、１００はノズル列、１１０はオリフィス孔、１２０はインク加圧室、１３０はインク流入孔、１５０はノズルセル、２１０はオリフィス板、２２０は長尺積層板、３００は駆動素子モジュール、３１０は駆動素子集積板である。また、Ａ、Ｂはインク流方向を示す。

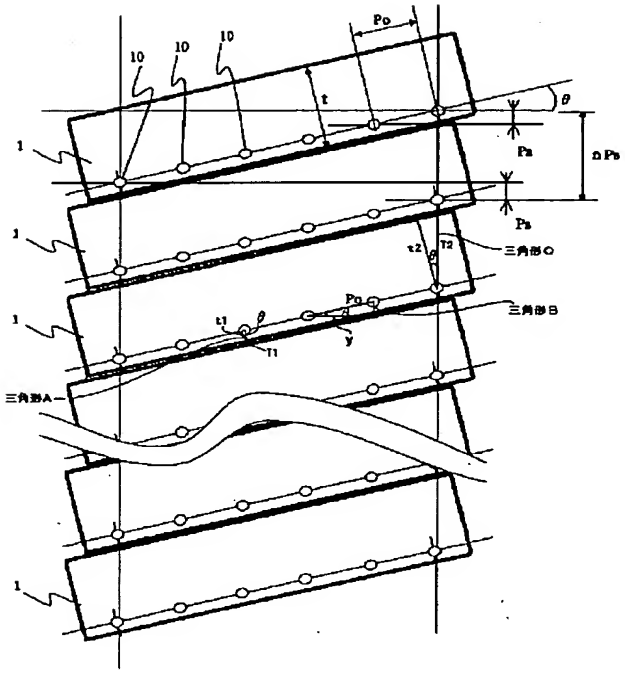
【図１】



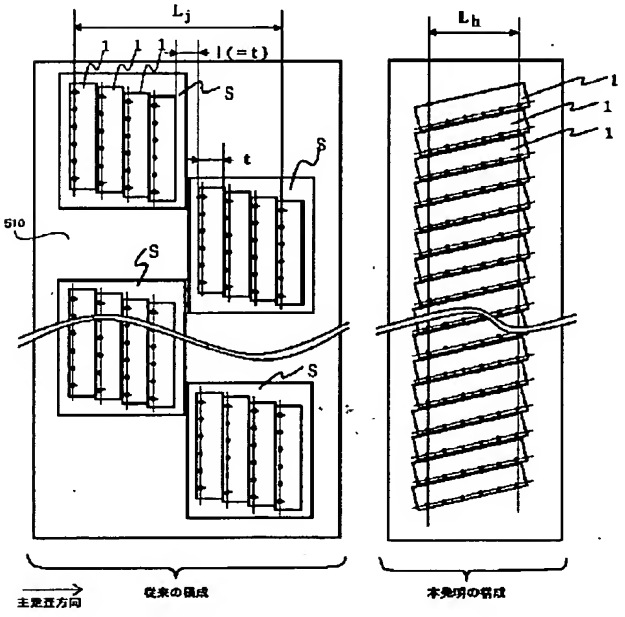
【図２】



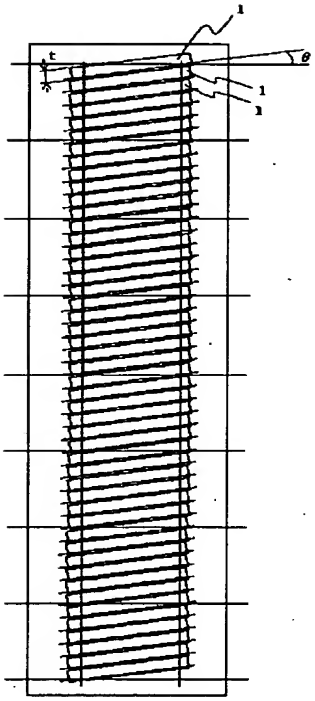
【図３】


Po
10
10
10
t
θ
Ps
ΔPs
1
1
1
三角部A
三角部B
三角部C
t1
t2
θ
γ

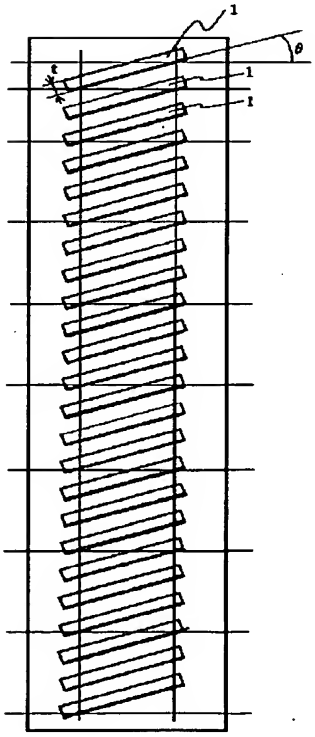
【図４】


Lj
Lh
1
1
1
l(=t)
S
S
S
S
t
510
1
1
1
主荷重方向
従来の構成
本発明の構成

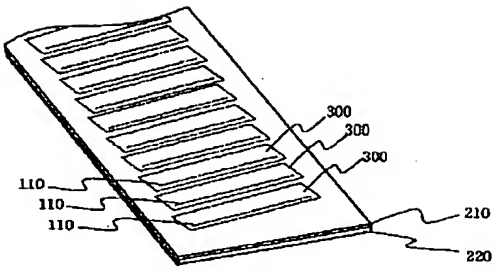
【図５】


1
t
θ
1
1

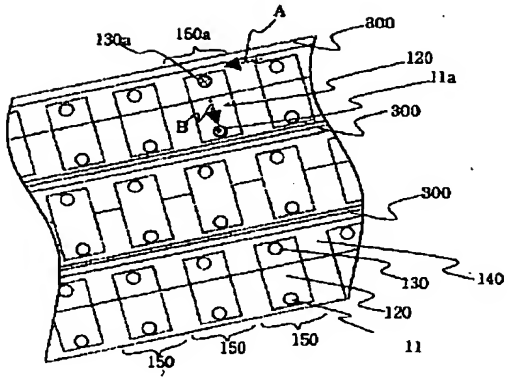
【図６】


1
t
θ
1
1

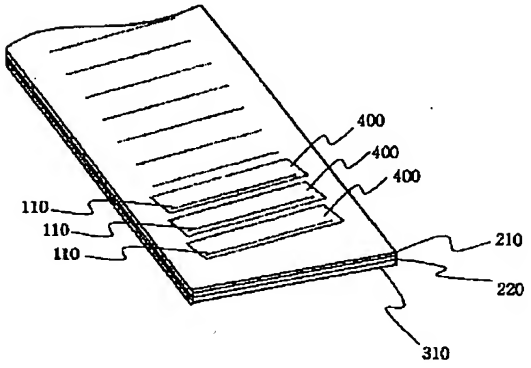
【図７】



【図８】



【図９】



【図１０】

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